Lloyd's Register

Rules and Regulations for the Classification of Naval Ships, January 2012

Notice No. 1

Effective Date of Latest Amendments:

See page 1

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RULES AND REGULATIONS FOR THE CLASSIFICATION OF NAVAL SHIPS, *January 2012*

Notice No. 1

This Notice contains amendments within the following Sections of the *Rules and Regulations for the Classification of Naval Ships, January 2012.* The amendments are effective on the dates shown:

Volume	***Part***	***Chapter***	***Section***	***Effective date***
1	1	2	3, 4	1 January 2013
1	1	3	16, 17	1 January 2013
1	3	2	4	1 January 2013
1	3	4	4, 7, 8, 10	1 January 2013
1	4	1	1, 4	1 January 2013
1	4	1	2	Corrigenda
1	4	2	3, 5, 7	1 January 2013
1	5	3	4	1 January 2013
1	6	1	2	Corrigendum
1	6	4	2	Corrigendum
1	6	5	3	Corrigendum
2	10	1	19	1 January 2013
3	1	6	Whole Chapter	1 January 2013

It will be noted that the amendments also include corrigenda, which are effective from the date of this Notice.

The *Rules and Regulations for the Classification of Naval Ships, January 2012* are to be read in conjunction with this Notice No. 1. The status of the Rules is now:

Rules for Naval Ships	Effective date:	January 2012
Notice No. 1	Effective date:	1 January 2013 & Corrigenda

Volume 1, Part 1, Chapter 2
Classification Regulations

Effective date 1 January, 2013

■ *Section 3*
Character of Classification and Class notations

3.7 Military Distinction notations

Table 2.3.1 Hull, Military and Other Class Notations (*Part only shown*)

Mandatory Notations		Other Notations		
Ship Type	Service Area	Hull Strength	Military Distinction ✠ MD	Others
See 3.4 (Select one:)	*See* 3.5 (Select one:)	*See* 3.6	*See* 3.7	*See* 3.9 **LE** Lifting Eyes **STAB** Buoyancy, Stability and Controllability Assessment

3.9 Other notations

3.9.22 Where it can be demonstrated that the vessel meets all of the buoyancy, stability and controllability performance requirements of the latest edition of Chapter III of the ANEP-77 NATO Naval Ship Code (NSC), a ship will be eligible to be assigned the **STAB** notation.

3.9.23 **LE**. This notation will be assigned where the lifting eyes, with a permissible loading of 2,5 tonnes or less, installed for the purpose of shipping and unshipping equipment and machinery, and which do not form part of a lifting appliance, are of an approved design, tested during construction and inspected through life in compliance with the requirements of Pt 3, Ch 4,10.

■ *Section 4*
Surveys – General

4.5 Existing ships – Periodical Surveys

4.5.3 The Owner should notify LR whenever a ship can be examined in dry dock or on a slipway. An inspection of the underwater hull and its appendages is to be carried out not less than twice every six years. The maximum period between inspections of the hull and its appendages in dock or in-water is not to exceed three and a half years. Consideration may be given at the discretion of LR to any special circumstances justifying an extension of the maximum periods between inspections. A **Docking Survey** is to be carried out concurrently with the Special Survey. The required Docking Survey is considered to coincide with the Special Survey when held within the six months prior to the due date of the Special Survey. *See* 4.5.5. Where the Special Survey of the hull is carried out on a Continuous Survey basis, as given in 4.5.10, the survey in dry-dock may be held at any time within the six-year cycle.

Volume 1, Part 1, Chapter 3

Periodical Survey Regulations

Effective date 1 January, 2013

■ *Section 16*

Classification of ships not built under LR survey

16.2 Hull and equipment

16.2.1 Plans showing the main scantlings, corrosion margins and arrangements of the actual ship together with any proposed alterations are to be submitted. As a minimum the plans are to comprise a midship section, longitudinal section and decks. LR may request further plans. Documents demonstrating compliance with appropriate standards recognised by the Naval Authority are to be submitted. In the absence of such documentation, an appraisal may be required to the satisfaction of LR. ~~These should comprise plans of the midship section, longitudinal section and decks, and such other plans as may be requested.~~ For vessels which have generated sufficient evidence of satisfactory in-service experience LR may consider this in lieu of compliance documentation or an appraisal. If plans cannot be obtained or prepared by the Owner, facilities are to be given for LR's Surveyor to obtain the necessary information from the ship.

16.3 Machinery

(*Part only shown*)

16.3.1 ~~To facilitate the survey, plans~~ Plans of the following items (plans of piping are to be diagrammatic), together with the particulars of the materials used in the construction of the boilers, air receivers and important forgings are to be ~~furnished~~ submitted. Documents demonstrating compliance with appropriate Standards recognised by the Naval Authority are to be submitted. In the absence of such documentation, an appraisal may be required to the satisfaction of LR. For vessels which have generated sufficient evidence of satisfactory in-service experience LR may consider this in lieu of compliance documentation or an appraisal:

■ *Section 17*

Classification of ships built under survey to LR Classification Rules and Regulations other than LR Naval Ship Rules and Regulations

17.2 Hull and equipment

(*Part only shown*)

17.2.1 Plans showing the features of the ship not covered by ~~merchant classification~~ the other Classification Rules against which the ship is classed are to be submitted. These may include the following ~~which should be addressed for~~ items. For these items, documents demonstrating compliance with appropriate Standards recognised by the Naval Authority are to be submitted. In the absence of such documentation, an appraisal may be required to the satisfaction of LR. For vessels which have generated sufficient evidence of satisfactory in-service experience LR may consider this in lieu of compliance documentation or an appraisal. Where an appraisal is undertaken, strength and, where appropriate, stiffness aspects are to be addressed:

17.3 Machinery

(*Part only shown*)

17.3.1 ~~To facilitate the assessment and survey~~ Plans of systems not covered by the other Classification Rules ~~with~~ against which the ship is classed~~, the following information with supporting plans is~~ are to be submitted to LR. For these systems, documents demonstrating compliance with appropriate Standards recognised by the Naval Authority are to be submitted. In the absence of such documentation, an appraisal may be required to the satisfaction of LR. For vessels which have generated sufficient evidence of satisfactory in-service experience LR may consider this in lieu of compliance documentation or an appraisal:

(a) Aircraft/helicopter and vehicle fuel storage and distribution systems.

Volume 1, Part 3, Chapter 2

Ship Design

Effective date 1 January, 2013

■ *Section 4*

Bulkhead arrangements

4.7 Watertight doors and hatches in watertight subdivision boundaries below the vertical extent of watertight integrity

4.7.2 ~~Watertight doors of the sliding type are to be capable of being operated~~ Where watertight doors of the sliding type are permitted to be fitted by the Naval Authority, they are to be capable of being operated by efficient hand operated gear, both at the door itself and from an accessible position above the vertical limit of watertight integrity. Means are to be provided at all the remote operating ~~position~~ positions to indicate whether the door is open or closed. ~~The lead of shafting is to be as direct as possible and the screw is to work in a gunmetal nut, *see also* 4.11.1.~~ Power operated doors are to be capable of being remotely closed from the appropriate control station.

4.7.5 ~~Doors and hatches are to be capable of being operated from both sides of the watertight division and from an accessible position above the vertical limit of watertight integrity.~~ Watertight doors and hatches are to be capable of being operated from both sides of the watertight division. Power operated ~~sliding~~ doors are to be capable of being opened and closed locally by both power and efficient hand operated mechanisms.

~~*4.7.6* Watertight doors which are intended to be used whilst at sea are to be;~~

- ~~of the sliding type;~~
- ~~capable of being remotely closed from the bridge;~~
- ~~are not to be capable of being opened remotely from the bridge.~~

~~An audible alarm is to be provided at the doors' closure. The power, control and indicators are to be operable in the event of main power failure. Particular care is to be paid to minimising the effect of control system failure.~~

~~*4.7.7*~~ *4.7.6* As an alternative to ~~the~~ sliding doors ~~required by 4.7.6~~, special consideration will be given to the fitting of hinged watertight doors where it can be shown that they are as effective as the sliding type. Unless watertight doors are of the sliding type, a suitable system is to be ~~operated~~ installed to ensure that such doors remain closed when operating at an increased risk of collision or grounding.

~~*4.7.8*~~ *4.7.7* ~~Hinged weathertight doors may be fitted above the vertical limit of watertight integrity.~~ Doors are to be manufactured in accordance with a National Standard and tested following installation, *see* Pt 6, Ch 6.

Volume 1, Part 3, Chapter 4

Closing Arrangements and Outfit

Effective date 1 January, 2013

■ *Section 4*

Side lights and windows

4.1 General

4.1.15 Laminated toughened safety glass may also be used for windows but the total thickness will need to be greater than that required for the equivalent sized window using monolithic toughened safety glass. The equivalent thickness of laminated toughened safety glass is to be determined from the following formula:

$$T_{L1}^2 + T_{L2}^2 + ...T_{Ln}^2 = T_S^2$$

where

n = number of laminates
T_L = thickness of glass laminate
T_S = Rule thickness of toughened safety glass.

Alternative arrangements that do not meet the above thickness requirement will be specially considered, provided that equivalent strength and bending stiffness to that of a single, thermally toughened pane of thickness T_s can be demonstrated in a four-point bending test in accordance with EN-ISO 1288-3 or an equivalent recognised National or International Standard, using no fewer than ten samples. The lower limit of the 90 per cent confidence level interval for the laminated pane shall not be less than the same for monolithic toughened safety glass. Small scale punch test or ring-in-ring test methods shall not be used.

Section 7
Scuppers and sanitary discharges

7.1 General

7.1.3 Where the freeboard is such that the deck edge forming the vertical limit of watertight integrity is immersed when the ship heels 5° or less, scuppers and discharges which drain spaces below this deck, or spaces within intact superstructures or deckhouses on this deck fitted with efficient weathertight doors, ~~may~~ are to be led to the bilges in the case of scuppers or to suitable sanitary tanks in the case of sanitary discharges. Where the freeboard is such that the deck edge forming the vertical limit of watertight integrity is immersed when the ship heels greater than 5° then they ~~are to~~ may be led overboard and fitted with means of preventing water from passing inboard in accordance with 7.2.

Section 8
Bulwarks, guard rails, raised walkways and other means for the protection of crew and embarked personnel

8.3 Freeing arrangements

(*Part only shown*)
8.3.17 In ships having superstructures which are open at either or both ends to wells formed by bulwarks on the open deck, adequate provision for freeing the open spaces are to be provided as follows:

A_c = bulwark height correction factor taken as;

= 0 for bulwarks between 0,9 and 1,2 m in height

$$= 0{,}004 l_w \left(\frac{(h_b - 1{,}2)}{1{,}0} \right) \text{m}^2$$

for bulwarks of height greater than 1,2 m, and

$$= 0{,}004 l_w \left(\frac{(h_b - 0{,}9)}{1{,}0} \right) \text{m}^2$$

for bulwarks of height less than 0,9 m.

To adjust the freeing port area for the distance of the well deck above the weatherdeck, for decks located more than $0{,}5h_s$ above the weatherdeck, multiply by the factor $0{,}5\,(h_s/h_w)$.

Section 10
Lifting eyes

10.1 Application

10.1.1 The following Section covers the design appraisal, testing during construction and through-life inspection of lifting eyes, with a permissible loading of 2,5 tonnes or less, installed for the purposes of shipping and unshipping equipment and machinery, and where they do not form part of a lifting appliance. Where the requirements of this Section are complied with the optional notation **LE** may be assigned.

10.1.2 The Owner is to ensure that the eyes are located in appropriate locations to enable the shipping and unshipping of equipment and machinery.

10.2 Information to be submitted

10.2.1 The following documentation is to be submitted for approval:

- Documentation detailing the range of standard lifting points to be used, *see* 10.4.

10.2.2 The following information is also to be submitted:

- A register of all equipment and machinery which is required to be shipped or unshipped during service.
- Plans detailing the shipping and unshipping routes by compartment.
- A register of all lifting points specifying the detail type, tally information and test loads.

10.3 Materials

10.3.1 Materials are to be in accordance with an appropriate Standard agreed between LR and the Naval Authority.

10.4 Lifting points

10.4.1 Lifting eyes are to be manufactured in accordance with an appropriate Standard agreed between LR and the Naval Authority.

10.4.2 A range of standard lifting point detail designs are to be selected. The range of detail types is to be appropriate for the weight of equipment and machinery which is required to be shipped or unshipped and the method of transfer which is to be used. When considering the weight of equipment and machinery the weight of the lifting gear is to be included.

10.4.3 Each standard lifting point detail is to have the following information defined:

- Permissible loading – Vertical lift.
- Permissible loading – Along eye-plate 45 degrees lift (where applicable).
- Permissible loading – Across eye-plate 45 degrees lift (where applicable).
- Material of construction.
- Method of attachment to the ship's structure.
- Method of use.
- Manufacturer's test loads.

10.4.4 The safe working load (SWL) for each of the standard detail designs is to be validated by calculation. The design load to be applied is as follows:

- 2 × SWL for the vertical lift case.
- 1,5 × SWL for the 45 degree lift case.

The permissible stresses in Table 6.10.1 are not to be exceeded.

10.4.5 The weld stresses are also to be validated by calculation and confirmed as acceptable. For this purpose a factor of 0,7 is to be used.

Table 6.10.1 Permissible stresses

	Permissible stress
Bending and direct stress	$0{,}8\sigma_o$
Shear stress	$0{,}5\sigma_o$
Combined stress	$0{,}9\sigma_o$
Symbols	
σ_o = specified yield stress of the material, in N/mm^2	

10.5 Supporting structure

10.5.1 Lifting points are to be located at the intersection of structural members wherever possible.

10.5.2 The strength of the supporting structure is to be validated by calculation.

10.5.3 Where double tallying is used, *see* 10.6.2, the unused direction is to be checked at an angle of 45 degrees for a load 0,25 times the SWL.

10.6 Tallying

10.6.1 Each lifting point is to have a tally displayed which clearly defines the permissible methods of use and the permissible loading associated with each method.

10.6.2 In general, a lifting point will have a single tally all round capability or single tally vertical lift only. A double tally is only to be used where the supporting structure would be required to be strengthened to provide all round capability but where the planned method of use does not require all-round capability.

10.7 Testing

10.7.1 Each lifting eye is to be supplied with a Manufacturer's Test Certificate. A vertical lift and 45 degree lift test are to be carried out. The test load is to be 2 × SWL for the vertical lift arrangement and 1,5 × SWL for the 45 degree lift arrangement.

10.7.2 Once installed on board the ship each lifting eye is to be load tested to 2 × SWL in the vertical direction. Documentation detailing the test loads and testing arrangement used is to be submitted to LR.

10.7.3 The weld attachment to the ship's structure of each lifting eye is to be visually inspected by a Surveyor. Where requested, Magnetic Particle Inspection is also to be carried out and the results are to be submitted to LR.

10.8 Inspection during service

10.8.1 A maintenance and inspection regime is to be developed in accordance with a recognised Standard (e.g., Merchant Shipping and Fishing Vessels (Lifting Operations and Lifting Equipment) Regulations 2006), documented and confirmed as being implemented by the attending Surveyor. As a minimum the procedure is to:

- Define the Standard or applicable legalisation which is used to define a Responsible Person;
- Nominate an appropriate Responsible Person or persons;
- Detail any training which the Responsible Person is to receive;
- Detail any qualifications which the Responsible Person is to hold;
- State that lifting points are to be inspected by a Responsible Person prior to and after use;
- Mandate that a record is kept of when each lifting point was last inspected and by whom;
- Authorise the Responsible Person to request that the lifting eye is to be load tested in accordance with 10.7.2 upon inspection;
- Authorise the Responsible Person to remove the item from service should they consider it appropriate to do so.

Volume 1, Part 4, Chapter 1

Military Design

Effective date 1 January, 2013

■ *Section 1*
General requirements

1.4 Materials and welding

1.4.6 Where armour plating consisting of steels with a specified tensile strength of 1000 MPa or above is integrated into the ship's structure by welding, consideration should be given to the susceptibility of these materials to hydrogen cracking. The use of normal strength or higher strength steel of toughness grade D or higher in terms of Charpy V-notch fracture toughness should be considered as an intermediate transition material where the adjacent material is not already of this grade.

1.4.7 The proposed welding procedures are to be submitted for review, and are to be chosen to minimise the risk of hydrogen cracking. The following is recommended:

(a) The use of welding consumables and electrodes with low hydrogen content (less than 5 ml/100 g of deposited weld metal).
(b) The weld preparation and welding apparatus, consumables and electrodes are to be clean and dry and free from other sources of hydrogen such as lubricants and grease.
(c) Controlled preheat, interpass temperatures, cooling rates and post-heat treatment chosen in accordance with manufacturers' guidance and recognised welding standards.
(d) Weld sequence chosen to minimise the formation of residual stresses.
(e) The use of welding consumables of a higher strength than necessary should be avoided.
(f) Non-destructive examination should not be carried out before a period of 48 hours has elapsed from the time welding is completed.

1.4.8 The use of mechanical fasteners to secure armour plating should be considered as a means of removing the risk of hydrogen embrittlement as a result of the welding process. Where higher strength steel fasteners with Vickers hardness above 320 HV are used, consideration should also be given to the susceptibility of these materials to hydrogen cracking.

CORRIGENDA

■ *Section 2*
Survivability

2.1 General

2.1.6 The **assessment phase** looks in more detail at the vulnerability of the ship and uses explicit calculations to assess the capability of the ship based upon the relevant effects of threats such as blast pressure or fragment size. It is not necessary to define the actual weapon, just the consequences or effects of threats. A threat can produce a variety of effects, the manner in which the Rules currently address these effects is detailed in Chapter 2. In naval ship classification, notations are used to denote that a calculation for a particular threat has been reviewed. Currently, these are concerned with structural aspects only, though some aspects of machinery are indirectly addressed through other notations such as propulsion machinery redundancy, **PMR**, steering gear machinery redundancy, **SMR** and fire safety, ~~**FS**~~ **FIRE**.

2.2 Vulnerability

2.2.4 The methods used to control the spread of fire will have an effect on structural design, materials, fire insulation, fire divisions and openings, and must all be considered. One method used to control the spread of fire is zones and some guidance on the philosophy and structural requirements is provided in Section 7. However the precise requirements for fire detection, protection and extinction are to be defined by the Naval Authority. Where this is examined by LR in accordance with Pt 1, Ch 2,3.9.7 a ~~**FS**~~ **FIRE** notation may be assigned. Other methods include the use of smoke tight boundaries, insulation and fire fighting systems.

Effective date 1 January, 2013

■ *Section 4*
Military design guidance

4.1 Radar signature

4.1.1 The Owner is responsible for determining the level of signature control required and agreeing any resultant design to achieve the required levels. There are however, instances where signature levels are not specified but good design practice may be applied. The following is offered as guidance.

~~*4.1.1*~~ *4.1.2* All constructional details on the exposed surfaces of the hull, ~~and~~ superstructures, masts and equipment above the design waterline should be considered for their radar reflection properties.

~~*4.1.2* Structure that presents three orthogonal internally reflecting surfaces to an incoming radar signal are to be avoided. Superstructure overhangs, sponsons and equipment mounts are particular problem areas.~~

4.1.3 The Radar Cross Section (RCS) of the ship will primarily be controlled by shaping. This concentrates the returned energy into a small number of narrow beams, orientated in sacrificial directions or by directing the returned energy at an angle away from the incident energy. The extent of the orientation of the sacrificial directions should be agreed between the Owner and designer.

4.1.4 Appropriate modelling tools and expert judgement should be used for RCS calculation and assessment at various stages of the design iteration. Use of these tools and judgement should be agreed between the Owner and designer. Consideration should also be given to the RCS measurement of equipment.

~~*4.1.3*~~ *4.1.5* Flare and tumblehome as defined in Fig. 1.4.1 are to be used where possible on all otherwise vertical surfaces. The angle used should be greater than 6°. Consideration should be given to using a single or multiple elevation angles, *see* 4.1.3. This practice also eliminates the dihedral reflector potentially formed between a horizontal and a vertical surface.

~~*4.1.5* The use of conical structure should be avoided.~~

~~*4.1.6* Consideration should be given to the effects of clutter on exposed weather decks and the use of radar absorbent materials both of which can significantly reduce the radar cross-section.~~

4.1.6 Orthogonal corners give rise to high radar returns in the direction of the originating antenna. Creating dihedral or trihedral right angled reflectors should be avoided. This applies equally to disconnected orthogonal corners, where two (or three) surfaces do not meet but are orthogonal and a clear line of sight exists between them. This can include items such as: boat bays, reception areas, superstructure overhangs, sponsons and equipment mounts.

4.1.7 Corners which would otherwise be orthogonal should be made non-orthogonal by a minimum of 4°, i.e., avoiding an internal angle of between 86° and 94°. Any shaping which uses angles less than 4° could inadvertently be made ineffective by local plate deformation or build tolerances.

4.1.8 Where doors providing access to the deck penetrate sloped structure, it will be desirable for the door itself to be hung vertically on its hinges. To achieve this it is necessary to recess the door into the sloped plate. Where this approach is adopted, the structure of the door recess should be made non-orthogonal by rotating the vertical sides of the recess by a minimum of 4°.

4.1.9 Avoid single curved surfaces (such as cylinders or cones) with diameters greater than 30 mm. Consideration should be given to replace these items by combinations of flat plates (with appropriate orientations), shielding or choice of appropriate material property.

~~*4.1.4*~~ *4.1.10* The use of lattice type masts and equipment supports should be avoided.

4.1.11 Consideration should be given to reducing the amount of clutter (microgeometry) by design, hiding it behind bulkheads or shielding (i.e., shutters for when equipment is not in use).

4.1.12 Where the use of homogenous reflective material is impractical for shielding, a mesh of electrical conductive fibres with an appropriate mesh spacing to simulate a reflective surface over the radar frequency range of interest can be used. This can also be applied to windows and non-structural bulkheads. Where a mesh is applied to windows which may be used for navigation purposes consideration should be given to the effects on visibility.

4.1.13 The number of external ladders should be kept to a minimum. Where they are unavoidable, ladder uprights should be rotated to avoid forming dihedral corners with the bulkheads on which they are mounted. As an alternative, external ladders could be constructed from a material translucent to radar.

4.1.14 Consideration should be given to the use of radar absorbent materials either as appliqués or more preferably as an inherent part of the structure i.e., Structural Radar Absorbent Material (SRAM).

4.1.15 Composites are generally semi-transparent to radar and therefore attention should be paid to equipment/structures placed behind composite structures. Alternatively, consideration can be given to altering the composite properties, applying a metallic backing to the composite or by using SRAM.

Volume 1, Part 4, Chapter 2

Military Load Specification

Effective date 1 January, 2013

■ *Section 3*

Internal blast

3.7 Bulkhead arrangements

3.7.5 Under blast loading, large displacements of the bulkhead may occur. Any nearby structure or equipment is to be located so as to provide a minimum clearance of 350 mm from the bulkhead. This distance is generally appropriate for deck heights of between 2 m and 3 m. The minimum clearance for other deck heights will be specifically considered.

■ *Section 5*

Underwater explosion (shock)

5.3 Notation assessment methodology

5.3.1 The shock performance required is to be agreed between the Owner, the Naval Authority and the Shipbuilder. The agreement is to include requirements for:

- Local strength assessment;
- Detailed design;
- Seat design, shock mounts and system hangers;
- Hull valve design and integration;
- Global strength assessment;
- Shock qualification/testing of equipment;
- 1st of class shock trial.

It is recommended that seats, valves, piping and equipment are categorised into~~: vital,~~ essential and non essential~~.~~, *see also* Vol 2, Pt 1, Ch 1,3.1.1.

5.8 ~~Hull valve design guidance~~ Design guidance for hull valves, piping and seals

5.8.5 Consideration should be given to the attached piping and its capacity to withstand shock:~~. Flanged and welded connections are to be used adjacent to the hull valve. Adjacent piping is to be designed to allow the valve and hull to flex under shock with limited restraint.~~

(a) Detachable pipe connections should be kept to the minimum necessary for installation and maintenance requirements;
(b) Flanged and welded connections are to be used adjacent to the hull valve. Adjacent piping is to be designed to allow the valve and hull to flex under shock with limited restraint;
(c) Where necessary, piping shall be supported with shock resistant mounts at a sufficient number of locations commensurate with the design shock level. The selection of shock mounts should consider displacement capability, *see* 5.7. The response of the piping relative to equipment should be considered. Sufficient space between equipment and piping should be provided to ensure they do not contact each other in a shock scenario;
(d) The routing of piping should be developed to minimise the number and size of penetrations through bulkheads, *see* 5.5.11;
(e) The consequences of leakage from piping and fittings should be investigated;
(f) Brackets should not be welded direct to steel piping;
(g) Adequate division of vital piping systems to isolate damage should be considered;
(h) The shock resistance of flanged connections should consider bolt preload, anti-rotational locking devices where appropriate and performance of gaskets.

5.8.11 The potential for leakage from seals/glands under shock loading, and the consequences of leakage, are to be considered. The shock resistance of vital seals/glands, including stern-tube seals, is to be validated by shock qualification testing. The sealing efficiency of stern-tube seals should not be compromised by the anticipated axial, radial and angular shaft movements commensurate with the design shock level.

■ *Section 7*

Residual strength

7.2 Threat level determination

7.2.4 Where the **STAB** notation is assigned, the damage scenarios included in the residual strength assessment are to include grounding/raking and collision damages which are consistent with the compartment damage criteria specified by the subdivision and stability standard, *see* Vol 3, Pt 1, Ch 6,1.

Volume 1, Part 5, Chapter 3
Local Design Loads

Effective date 1 January, 2013

Section 4
Impact loads on external plating

4.3 Bow flare and ~~above waterline~~ wave impact pressures, IP_{bf}

4.3.1 This Section is applicable to:

(a) Bow flare region.

(b) Sides and undersides of sponsons.

(c) Other parts of the side shell plating close to and above the design waterline where there is significant flare and expected to be subjected to wave impact.

The bow flare wave impact pressure, wave impact pressure on sponsons and other parts of the side shell plating above the design waterline, IP_{bf}, in kN/m², due to relative motion is to be taken as:

$IP_{\mathrm{bf}} = 0{,}5\,(k_{\mathrm{bf}}\,V_{\mathrm{bf}}^2 + k_{\mathrm{rv}}\,H_{\mathrm{rv}}\,V_{\mathrm{rv}}^2)$ kN/m²

where

k_{bf} = hull form shape coefficient for wave impacts

$= \cancel{\dfrac{\pi}{\tan\beta_p}}\ \dfrac{\pi}{\tan\psi}$ for $\cancel{\beta_p}\ \psi \geq 10$

$= 28\,(1 - \tan(2\,\cancel{\beta_p}\ \psi))$ for $\cancel{\beta_p}\ \psi < 10$

V_{bf} wave impact velocity, in m/s, and is given by

$= \sqrt{V_{\mathrm{thbf}}^2 + 2m_1 \ln(N_{\mathrm{bf}})}$ for $N_{\mathrm{bf}} \geq 1$

$= 0$ for $N_{\mathrm{bf}} < 1$

V_{thbf} = threshold velocity for wave impact, in m/s, to be taken as:

$= \dfrac{\sqrt{10}}{\cos\alpha_p}$

N_{bf} = No. of wave impacts in a 3 hour period and is given by

$= 1720 PR_{\mathrm{bf}} \sqrt{\dfrac{m_1}{m_0}}$

PR_{bf} = probability of a wave impact and is given by

$= e^{-u}$

$u = \left(\dfrac{z_{\mathrm{wl}}^2}{2m_0} + \dfrac{V_{\mathrm{thbf}}^2}{2m_1}\right)$

k_{rv} = hull form shape coefficient for impact due to forward speed

$= \dfrac{\pi}{\tan(90 - \alpha_p)}$ for $\alpha_p \leq 80$

$= 28\,(1 - \tan(2\,(90 - \alpha_p)))$ for $\alpha_p > 80$

H_{rv} = relative wave heading coefficient

$= 1{,}0$ for $\gamma_p \geq 45$

$= \cos(45 - \gamma_p)$ for $\gamma_p < 45$ and ≥ 0

$= 0$ for $\gamma_p < 0$

V_{rv} = relative forward speed, in m/s

$= 0{,}515 V_{\mathrm{sp}} \sin(\gamma_p)$

α_p = buttock angle measured in the longitudinal plane, in degrees, *see* Fig. 3.4.1

~~β_p~~ ψ = effective deadrise angle ~~measured in the transverse plane,~~ in degrees~~, see Fig. 3.4.1. For bow flare regions where the bow is non prismatic, i.e., changing rapidly, then β_p may be taken as the maximum of α_p or β_p. Note final β_p is to be decreased by 10° with a minimum of 0° to allow for the effects of roll motion on the above waterline impact pressures for ships with $C_b \leq 0{,}6$~~.

For $C_b > 0{,}6$, ψ is to be taken as the maximum of α_p and β_p, *see* Fig. 3.4.1

For $C_b \leq 0{,}6$, ψ is to be taken as the maximum of α_p and β

where

$\beta = \beta_p - 10°$, but is to be taken as not less than 0°

NOTE

The 10° deduction is to allow for the effects of roll motion on the impact pressures.

γ_p = waterline angle measured in the horizontal plane, in degrees, *see* Fig. 3.4.1

C_b = Block coefficient as defined in Pt 3, Ch 1,5

z_{wl}, m_1, m_0 are defined in 4.2 but are to be calculated using:

f_{sl} = probability level correction factor for relative vertical motion

$= 1{,}0$ for ships $C_b \leq 0{,}6$

$= 1{,}2$ for ships $C_b > 0{,}6$

NOTES

Where only two angles are known and are measured in the orthogonal planes, then the third angle may be obtained by the following expression:

~~$\alpha = \tan^{-1}(\tan\beta\,\tan\gamma)$~~

$\alpha_p = \tan^{-1}(\tan\beta_p\,\tan\gamma)$

If the area of plating under consideration has a waterline angle which is re-entrant or decreasing, e.g. in the stern region, then the relative wave heading coefficient, H_{rv}, and the speed V_{sp}, used in the derivation of H_{rm}, are to be taken as zero. V_{sp} is defined in 1.3.1.

4.3.3 The extents around the girth of the bow flare wave impact pressure are to be derived as follows:

(a) the vertical slam extent, g_{bfv}, is to be taken as:

$g_{\mathrm{bfv}} = \dfrac{4}{\sin\cancel{\beta_p}\ \psi\,\sqrt{8k_{\mathrm{bf}}}}$ m

(b) the horizontal slam extent, g_{bfh}, is to be taken as:

$g_{\mathrm{bfh}} = 4$ m

where

k_{bf} and ~~β_p~~ ψ are given in 4.3.1.

Volume 1, Part 6, Chapter 1

General

CORRIGENDUM

■ *Section 2*
General requirements

2.3 Plans to be supplied to the ship

2.3.1 To facilitate the ordering of materials for repairs, plans listed in ~~2.4.1~~ 2.2.5 are to be carried on board the ship. They are to clearly indicate the disposition and grades (other than Grade A) of hull structural steel, the extent and location of higher tensile steel together with details of specification and mechanical properties, and recommendations for welding, working and treatment of these steels.

Volume 1, Part 6, Chapter 4

General

CORRIGENDUM

■ *Section 2*
Hull girder strength

2.5 Superstructures global strength

2.5.3 The design stress due to hull girder bending, σ_{hg}, in the uppermost effective tier at side may be derived according to the following formula:

$$\sigma_{hg} = \frac{\eta_s M_R}{1000 Z_s} \text{ N/mm}^2$$

where

M_R = hull girder bending moment at amidships due to sagging as determined in Pt 5, Ch 4,5, in kNm

Z_s = section modulus at the structural element being considered, in ~~cm^3~~ m^3. The section modulus is to include the superstructure tiers, assuming the tiers to be η_s effective

η_s = as defined in 2.5.2.

Volume 1, Part 6, Chapter 5
Structural Design Factors

CORRIGENDUM

■ *Section 3* Scantling determination for NS2 and NS3 ships

3.1 Design criteria

Table 5.3.1 Specification of design criteria value f_1

Failure mode	Stress factor	Column for f_1 in Table 5.3.2
Plating requirements		
Membrane stresses	f_σ	Use σ_x or σ_y column (1)
Local plate bending	f_σ	Use σ_b column
Shear stresses	f_τ	Use τ_{xy} column
Buckling, hull girder stresses	λ_σ	Use λ_σ column
Shear buckling, hull girder stresses	λ_τ	Use λ_τ column
Stiffener requirements		
~~Hull girder plus local bending~~	~~f_σ~~	~~Use σ_{vm} column~~
~~Local stiffener bending~~	~~f_σ~~	~~Use σ_x or σ_y column (1)~~
Section modulus	f_σ	Use σ_x or σ_y column (1)
Web area	f_τ	Use τ_{xy} column
Inertia	f_δ	Use f_δ column
Buckling modes	λ_σ	Use λ_σ column
NOTE Use the σ_x or σ_y column as appropriate to the structure under consideration.		

Volume 2, Part 10, Chapter 1

Local Design Loads

Effective date 1 January, 2013

■ *Section 19*

Ship safety systems

19.1 Watertight doors

19.1.9 The door shall have an approximately uniform rate of closure under power. The closure time, from the time the door begins to move to the time it reaches the completely closed position, shall in no case be less than 20s or more than 40s with the ship in the upright position.

~~*19.1.9*~~ *19.1.10* Sliding watertight doors are to be capable of being remotely closed from the bridge and are also to be operable locally from each side of the bulkhead. Indicators are to be provided at the respective control positions showing whether the doors are open or closed, and an audible alarm is to be provided at the door closure.

~~*19.1.10*~~ *19.1.11* A central operating console is to be fitted on the navigating bridge and is to be provided with a 'master-mode' switch having:

(a) ~~a 'local control'~~ an 'in port' mode, ~~for normal use~~ which is to allow any door to be locally opened and locally closed after use without automatic closure; and

(b) ~~a 'doors closed'~~ an 'at sea' mode, ~~for emergency use~~which is to allow any door that is opened to be automatically closed whilst still permitting any doors to be locally opened but with automatic reclosure upon release of the local control mechanism.

~~*19.1.11*~~ *19.1.12* The 'master mode' switch is to be arranged to be normally in the ~~'local control'~~ 'at sea' mode position; be clearly marked as to its ~~emergency~~ function and be Type Approved in accordance with LR's Procedure for Type Approved Products.

~~*19.1.12*~~ *19.1.13* The central operating console at the navigating bridge is to be provided with a diagram showing the location of each door, with visual indicators to show whether each door is open or closed. A red light is to indicate a door is fully open and a green light, a door fully closed. When the door is closed remotely a red light is to indicate the intermediate position by flashing. The indicating circuit is to be independent of the control circuit for each door.

~~*19.1.13*~~ *19.1.14* The arrangements are to be such that it is not possible to remotely open any door from the central operating console.

Volume 3, Part 1, Chapter 6

Buoyancy, Stability and Controllability Assessment

Effective date 1 January 2013

■ *Section 1*

General

1.1 Application

1.1.1 The application of the additional requirements of this Chapter offers solutions for compliance with the buoyancy, stability and controllability performance requirements of Chapter III of ANEP-77 NATO Naval Ship Code (NSC) which have not already been addressed by application of the standard naval classification requirements. Where the optional requirements of this Chapter are applied, and it can be demonstrated that the vessel meets all of the performance requirements of the latest edition of the NSC Chapter III, a ship will be eligible to be assigned the **STAB** notation.

1.1.2 For compliance with the requirements of this Chapter the **RSA2** and **LMA** notations must also be assigned.

1.1.3 Where a loading instrument is provided on board the **LI** notation must be assigned.

1.1.4 Where a stability calculation program is provided it is to be approved in accordance with Lloyd's Register's (hereinafter referred to as LR) *Approval of Longitudinal Strength and Stability Calculation Programs*.

1.1.5 A suitable subdivision and damaged stability standard, which complies with the performance requirements of Chapter III of the NSC, is to be specified by the Naval Authority and agreed with LR, *see* Vol 1, Pt 1, Ch 2,1.1.9.

1.1.6 A suitable intact stability standard which complies with the performance requirements of Chapter III of the NSC is to be specified by the Naval Authority and agreed with LR, *see* Vol 1, Pt 1, Ch 2,1.1.9.

1.1.7 Where the Naval Authority requires specific extreme damage or extreme flooding events to be assessed, over and above the events inherent in the standards above, those extreme events are to be defined in the CONOPS.

1.1.8 A seakeeping analysis or model tests are to be undertaken, *see* 2.4.1. The range of environmental conditions used in the analysis or tests are to be consistent with the CONOPS (e.g. specific headings for aircraft opertions).

1.2 Information and plans

1.2.1 Information required to be submitted:

(a) Information regarding operation of the vessel:
  - CONOPS.
  - Seakeeping analysis report or model test results.

(b) Information required to be submitted for approval:
  - C11(N).
  - Stability Information Book, *see* 2.5.1.

(c) Information regarding the ship's equipment:
  - A register of essential life saving equipment.

1.2.2 Information required to be provided on board:

(a) Plans:
  - Watertight and weathertight integrity plan.

(b) Instructions:
  - Instructions covering the operation of watertight doors whilst at sea.

(c) Information:
  - Register of safety points, *see* 2.4.3.
  - Procedure for visual inspection of safety points by Responsible Persons.
  - Record of Approved Safety Equipment.
  - Approved Stability Information Book.
  - Information covering ship operations in heavy weather and during manoeuvring, *see* 2.5.2.
  - Dry-docking information, *see* 2.5.3.

■ *Section 2*
Requirements

2.1 Watertight integrity

2.1.1 Watertight doors below the level of watertight integrity which are intended to be used whilst at sea are to comply with the requirements of Vol 1, Pt 3, Ch 2,4.7 and Vol 2, Pt 10, Ch 1,19.1. The door is to be clearly marked in accordance with the procedure specified in 1.2.2(b), stating that the appropriate authority is to be sought prior to operation of the door.

2.1.2 All main watertight subdivision compartments are to be fitted with means of water ingress detection. Water ingress is to be indicated at all main control stations and a suitable audible alarm is to be provided. The number and location of flooding detection sensors is to be sufficient to ensure that any substantial water ingress into a main subdivision compartment is detected under reasonable angles of trim and heel.

2.2 Reserve of buoyancy

2.2.1 LR will verify compliance with the agreed subdivision and damaged stability standard. Where the Naval Authority specifies an exception to the standard or non-compliances occur they are to be recorded in the tailoring document, *see* Vol 1, Pt 1, Ch 2,3.11.

2.2.2 The definitions of damage for the assessment of the **RSA2** notation are to include damages which are consistent with the compartment damage criteria specified by the subdivision and damaged stability standard, *see* Vol 1, Pt 4, Ch 2.

2.3 Reserve of stability

2.3.1 LR will verify compliance with the agreed intact stability standard. Where the Naval Authority specifies an exception to the standard or non-compliances occur they are to be recorded in the tailoring document, *see* Vol 1, Pt 1, Ch 2,3.11.

2.4 Safety of embarked persons

2.4.1 The results of the seakeeping analysis or model test are to demonstrate that the predicted RMS motions, deck wetness, Motion Induced Interruptions (MII) and Motion Sickness Incidences (MSI) for the design are within the limits specified in STANAG 4154 or another appropriate standard specified by the Naval Authority. Values are to be predicted or recorded at the following locations as a minimum, where applicable:

- Navigation bridge.
- Machinery control room.
- Flight deck.
- RAS operating positions.
- Well-deck.

2.4.2 Work stations are to be fitted with suitable arrangements, e.g., handholds/seatbelts/harnesses to enable the crew to perform their duties when adverse ship motions occur. The fittings and their supporting arrangements are to be to the Surveyor's satisfaction.

2.4.3 Where safety points for attaching harnesses are provided on board they are to be selected from, and installed in accordance with, an appropriate standard (e.g., BS EN 795). A Register of safety points is to be produced at build and maintained in service. A procedure for the visual inspection of safety points by a Responsible Person is to be developed and confirmed as being implemented. As a minimum the procedure is to:

- Define the standard or applicable legalisation which is used to define a Responsible Person;
- Nominate an appropriate Responsible Person or persons;
- Detail any training which the Responsible Person is to receive;
- Detail any qualifications which the Responsible Person is to hold;
- State that safety points are to be inspected by a Responsible Person at least every 12 months;
- Mandate that a record is kept of when each safety point was last inspected and by whom;
- Authorise the Responsible Person to request that the safety point is to be load tested in accordance with the applicable standard;
- Authorise the Responsible Person to remove the item from service should they consider it appropriate to do so.

2.5 Provision of operational information

2.5.1 A Stability Information Book is to be provided on board containing the following information:
(a) The stability standard or requirements;
(b) General precautions against capsize;
(c) Loading and operating restrictions;
(d) Cross-flooding arrangements [if fitted];
(e) Verification of compliance with the stability standard;
(f) Trim and draught limitations;
(g) Free surface effects;
(h) Payload heeling effects;
(j) Loading and unloading precautions;
(k) Securing arrangements;
(l) Control of openings;
(m) Loll;
(n) Hull strength;
(o) Stability or loading computer [if fitted];
(p) Non sailing conditions [if applicable];
(q) Particulars of the ship;
(r) Details of the lightship and its derivation;
(s) Details of hydrostatics and cross curves of stability;
(t) Capacity and centroid of tanks, stores and cargo spaces plus other payload data;
(u) Example calculations of stability;
(v) Example ship conditions compliant with stability requirements;
(w) Damage stability information demonstrating ship survivability following foreseeable, extreme and and catastrophic damage; and
(x) Methods to recover margins of buoyancy and stability.

2.5.2 Information regarding ship operations in heavy weather or during manoeuvres shall be provided on board. The information shall contain as a minimum:
(a) The risk of broaching;
(b) The shipping of green seas;
(c) Slamming;
(d) Heel in turn characteristics;
(e) The impact of motions on the safety of the crew and essential safety functions;
(f) Practices or methods specific to the vessel to reduce the impact of motions on the safety of the crew and equipment;
(g) The effects of squat and manoeuvring in shallow water;
(h) The effects of wind on manoeuvring; and
(j) The minimum manoeuvring speed.

2.5.3 Information on dry-docking the ship shall be provided on board. The information provided shall be consistent with Vol 1, Pt 3, Ch 5,10.2 and contain as a minimum:
(a) The location of dock blocks and lightship weight distribution;
(b) The location of discharges, shore connections and appendages; and
(c) Information for maintaining stability throughout the dry-docking process.

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